

TABLE 1.—Hourly precipitation, inches and hundredths, at Miami, Fla., May 27 to June 19, 1930, inclusive

[Traces omitted]

Date	A. M.												P. M.												Total
	1	2	3	4	5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8	9	10	11	Mid- night	
May 27											0.33	0.86	0.30		0.02										1.51
May 29																	0.88	0.72					0.03	0.02	1.65
May 30		0.03				0.02		0.03			.01			0.23	.04	0.01									.37
May 31				.02	.02								.01	.14	.94	1.22	1.51	.72	.02	.03	.01	.08	.02	.08	4.82
June 1	.03			.03	.21	.17	.08	.03	.05	1.87	1.20	.30	.32	.33	.12	.02	.33	.20	1.02	.37	.24	.13	.09	.03	7.17
June 2	.64	.42	.72	.10	.16	.14	.12	.16	.09	.12	.44	.71	.56	.22	.04		.03		.02	.42	.15	.01			5.27
June 5				.02																					.02
June 7				.03																					.03
June 8			.07	.17	.01										.01			.19	.10	.87	.53	.94			2.89
June 9										.02	.05	.95			.03	.01									1.06
June 10				.08																	.02				.05
June 11																					.01				.01
June 12																					.02	.78	1.58	.52	2.90
June 13	.23	.04										.01	.01	.02	.06	.01	.03	.07	.05	.07	.02	.02	.01	.05	.70
June 14		.01		.05	.01																				.07
June 15							.02			.07	.09	.01		.54		.81	.08			.01					1.63
June 17		.06																		.09	.07	.43	.80		1.45
June 18			.07														.03	.02							.12
June 19			1.44																						1.44
Sums	.90	.56	2.30	.45	.41	.33	.22	.22	.14	2.08	2.12	2.84	1.20	1.48	1.23	2.10	2.90	1.92	1.21	1.86	1.07	2.39	2.53	.70	33.16

NOTES, ABSTRACTS, AND REVIEWS

An upper air temperature indicator for use with pilot balloon, by G. Chatterjee. Reprinted from "Gerlands Beiträge zu Geophysik," vol. 24 (1929), pp. 343-352, Vienna.—Author's summary: The paper describes a simple instrument intended to be used with ordinary pilot balloons for determining temperature levels in the atmosphere. The instrument is essentially a 2-pronged fork in which both prongs are bimetallic strips that open outwards as the temperature falls. At a set temperature, the opening of the prongs releases a chemical "trigger" by allowing a very small capillary U-tube containing strong sulphuric acid to drop into a finely powdered mixture of sugar and potassium chlorate. This burns the string holding the instrument to the balloon. The release of the instrument from the balloon at the predetermined temperature is observed in the field of view of a theodolite and the height of the balloon at the moment is determined by the tail method. The weight of the instrument is about 40 grams.—C. F. B.

The electric field of overhead thunderclouds,¹ by S. K. Banerji.—Changes in the electric field produced by eighteen thunderclouds during their passage over the Colaba Observatory in 1929 suggest that the majority were of the "unitary type" and had their front part negatively charged, the central part positively charged, and the rear negatively charged. A few were of the "double type" and produced changes in the field as if two thunderclouds of unitary type had passed over in succession. In those thunderclouds which caused heavy rainfall, fluctuations in the central positive field occurred by loss of charge by rainfall or by increased concentration of positive charge by increased vertical current, in agreement with the breaking-drop theory. The monsoon clouds produced an electric field which was preeminently negative during periods of rainfall.

A new rainfall chart of the earth.²—The author has collected, mainly from World Weather Records and the volumes of *Reseau Mondial* 1911-1920, more than 500 records of precipitation for the 10 years, 1911-1920. The majority of the records cover the full 10 years, those which have less than 9 years have been adjusted

to the full period and used in the compilation of the chart. The latter is on a scale of 1:100,000,000, and shows the distribution of rain over land and sea according to the following scale of intervals: 0-25, 25-50, 50-100, 100-150, 150-200, 200-300, 300 and more centimeters.—A. J. H.

The rôle of the oceans in the weather of western Europe,³ by C. E. P. Brooks, D. Sc.—Doctor Brooks is the author of two Geophysical Memoirs, Nos. 34, 1926, and 41, 1928, bearing upon the influence of oceanic currents and Arctic ice, respectively, upon the weather of Europe. In the present paper he draws upon the information presented in those memoirs to elaborate and present in much detail his ideas as to the bearing of oceanic conditions upon the weather of adjacent land areas.

In his opening paragraph he likens the North Atlantic to a great bath having one hot and two cold taps; the hot tap is, of course, the Gulf Stream and the two cold ones the Labrador and East Greenland currents. These taps are always running sometimes at full capacity and at others much diminished in volume.

Some curious interrelationships are described, one in particular will be mentioned. This relates to the pressure variations at Iceland and the west coast of Ireland following variations of the ice index of 5 units above normal. The ice index is merely a convenient unit to express the distribution of ice in Kara Sea, Greenland Sea and Barents Sea. It was computed for each year from 1895 to 1928 during which period its largest value was 145 in 1917, a year of rather low winter temperature in both Europe and North America.

The relations between variations of the ice index and subsequent pressure changes in Iceland and Valencia are striking. The author remarks in this connection:

These curious relationships present some difficult problems for the meteorologist to solve, especially the reason why a large amount of ice in the Arctic should cause high pressure and fine weather at one season, low pressure and stormy weather at another season. We may summarize the position as follows:

(1) When there is much ice in the Arctic, pressure in spring and summer tends to be above normal in the northwest (Greenland, Iceland, and the Faroes) and below normal in the southwest (the Azores).

¹ Reprinted from *Nature*, May 10, 1930.

² Erwin Ekhardt in *Petermanns Mitteilungen* Heft 3/4.

(2) When there is much ice in the Arctic in spring and summer, pressure in the following late autumn and winter (November to January) tends to be below normal over the British Isles and northern France.

(3) Similar effects tend to occur annually at northern stations for about four years following abnormal ice years.

Space does not permit us to go into details as to how the ice and cold water react on the atmosphere to produce the results outlined above.—A. J. H.

RAINFALL-ALTITUDE

Notes on rainfall and evaporation, by Dr. G. E. P. Smith, irrigation engineer, University of Arizona, Tucson, Ariz.—In 1910 I published a chart showing by graphs the approximate relation of rainfall to altitude in this region. The chart has curves for two contiguous areas, one for Pinal and Pima Counties, one for Cochise and Graham Counties. To assist in weighting the records, the length of each record is represented by the size of the plotted point. The Pinal-Pima curve shows equal rainfall for elevations about 1,000 to 1,500 feet below the Cochise-Graham curve.

These curves are criticised in Mead's textbook on Hydrology, as follows: "The author (Mead) has been unable to ascertain any adequate reason for the differentiation between these counties, or for the belief that there is any increase in annual rainfall above the 4,000-foot contour." The answer to both of these points is topographic relations. The rainfall at any locality is dependent upon the relation of its altitude and exposure to the surrounding country. In Cochise and Graham Counties, the valley floors are higher and in general the mountains are higher. If the entire State and northern Sonora were raised bodily 1,000 feet the rainfall at each point might not be changed. The influence of local topography also will prevent the plotted points from falling on a smooth curve. It is probable that there should be a reverse flexure at approximately 7,000 feet the altitude of the top of the steepest part of the mountain sides. I think that a query more difficult to answer would be, "Why should the rainfall in Pinal County be equal to that in Cochise County?"

TRANSPIRATION FROM FORESTS

At Redington, a neglected part of this State, there are two mature forests, one of cottonwood and one of mesquite, situated about 4 miles apart. Some years ago I studied the transpiration of these forests as measured by the effect on the ground-water table. A consistent, variable, diurnal curve was recorded throughout the year except for the winter when the trees were defoliated and during that period the rise and fall of the water table recorded accurately the approach and departure of storms.

By comparing the water-table curves with meteorologic conditions, it was seen that transpiration was influenced by temperature, humidity, cloudiness, and other climatic factors.

The transpiration curve derived from the water-level records does not "follow" the temperature or humidity curves, but leads them both.

Cloudiness must be a factor of importance. On many dates it is apparent that during the cloudy part of the day the water loss is greatly reduced. However, on June 3, the date of the great Pueblo flood, I was at Redington and observed that the sun was not visible during the day save for a few minutes about midafternoon, but the transpiration was almost normal, at least

within 10 per cent of the water loss of the preceding day, which was clear. The day was peculiar, in that the haze was very high and there were no drifting clouds of the usual sort. The temperature on that day was below normal. The inference is that temperature and humidity, rather than sunlight, are the direct factors, or at least that the light itself is of less importance than is usually stated.

The beginning of transpiration effects in early spring occurs at the time of budding. The budding itself does not seem to entail much water loss and, quite peculiarly, during the early period of leafing the loss appears to be continuous throughout the 24 hours. Possibly the latter phenomenon is due to replenishment of the sap after the dormant period. In the cottonwood forest the descent of the water table began on March 1, though budding started several days earlier. The nocturnal recharge began to show on March 18. In the mesquite forest the descent of the water table and the budding began April 15, and recharge showed on the 25th.

RECAPTURE OF WATER SUPPLY

The total stream flow of the Colorado River system available for irrigation use is approximately 21,000,000 acre-feet annually. Of this total, approximately 13,000,000 acre-feet is discharged into the Gulf of California. Time will come, perhaps in 40 years, when nearly all of that 13,000,000 acre-feet will be applied in irrigation use and will be evaporated from the basin, mostly from the portion of the basin south of the Grand Canyon. The prevailing winds are from southwest to northeast and during periods most favorable to summer rainfall the winds are from southeast or east. In either event much of the vapor will be carried toward high mountain ranges within the river basin and it is conceivable that 15, even 25 per cent of the quantity may be recovered by orographic rainfall. This may add to the total available supply 2,000,000 or 3,000,000 acre-feet of water, sufficient to irrigate an area greater than the total under irrigation in Arizona at the present time.

RAINFALL CYCLES

A graph of the Tucson rainfall shows a 34-year period, and any subcycle within this of minor importance. California hydrologists discuss a 35-year cycle, though Sonderegger points to a 22-year cycle in southern California. Doctor Douglass has quite a number of periods with which he toys on state occasions. Too many cyclic periods have been proposed. It would appear that causes of variation are multifarious, and the problem, though worthy of research, is not to be easily solved. I am attracted also by the problem of balance between different storm paths. The Nile maximum stream flow occurs at periods of low rainfall in Europe. Rainfall in Idaho and Arizona may be of opposite phase, and I have noticed that during droughts Arizona stockmen have shipped cattle to Idaho and Montana has shipped to Texas.

Although the Tucson rainfall chart makes a pretty picture, I have not much faith that it will go on repeating itself, or that meteorologists will ever be able to make long-range wet-or-dry forecasts with more than 50 per cent accuracy.

EROSIONAL TERRACES

My office has mapped the physiographic areas surrounding Tucson. There are four well-defined terraces,

each representing a distinct uplift or change in climate, and a distinct epoch or time. Logs of wells prove that, in at least two cases, the erosion was carried beyond present levels and was followed by aggradation to the terrace levels as we find them. Whether there was any periodicity in the successive erosions and refillings is beyond human ken.

SUMMER RAINFALL

The summer rainfall of Arizona is unique, and offers a fascinating field for study. The typical rains are local in character, though in exceptional cases there is general rainfall over much of the State. The typical valley rain is a thunderstorm, originating at the base of a mountain or more often at the base of a mountain pass, and proceeding rather leisurely along the valley with width of from a half mile to several miles. It may continue for 40 miles or more before it dies out or moves out of observation through a pass. The best immediate indication is that the massive cumulus clouds that build up over the mountains at noon move out in a northwesterly or westerly direction, regardless of the direction of surface breeze. If the clouds at noon move east or northeast, there is little likelihood of rain.

Most of these storms occur between 3 p. m. and midnight, and by morning the sky is clear again.

As pointed out by Weather Bureau forecasters, favorable conditions for summer rains are indicated by the presence of a wedge or area of high pressure from the northwestern states reaching down as far as Colorado or even into New Mexico. The circulation of such areas combined with the summer "low" of the lower Colorado Valley must induce a strong movement of air in a general northwesterly direction. A possible hypothesis is that the ascent of the heated air of the valleys is accompanied by the descent of moisture-laden air from the tropics that has been cooled over the mountains of Mexico.

*South African rainfall, effectively presented by new graphical method.*⁴—The wide variation in rainfall from place to place in South Africa, and the fact that nearly 73 per cent of the Union has rainfall of less than 25 inches lends value to this report of station data with maps. Average monthly and yearly rainfall, in inches, for about 7,500 stations is given, the data being presented as from October around the year to September, because the seasons of precipitation are thus more clearly shown than in the usual January to December arrangement. An index directs the reader to sectional maps (squares of 2° longitude by 3° of latitude, scale of 20 miles to the inch), showing location of all reporting stations and detailed distribution of rainfall by isohyets for each 5 inches. The material is summarized in three large colored maps in a pocket.

The general map of average annual rainfall for the region south of latitude 22° S. (scale 40 miles to the inch) is notable because of the detail and very small areas of differing rainfalls noted thereon. The color scheme has been adopted to distinguish particularly that portion of South Africa having less than 25 inches annually from the more humid sections. Ascending scales in intensity of coloring have been used from white through yellow to dark orange for the 0 to 25 inches regions and from green through red and blue to black for 25 to 100 or more inches of rainfall. Due to paucity of records for certain

areas, the author has used his personal knowledge of the topography and vegetation of the country to assist in guiding the isohyets.

Being a plateau with rugged borders exposed to the southeast trades and the prevailing westerlies off the ocean the rainfall is as high as 100 or more inches on the highest peaks, while there are scattered areas of 25 to 50 inches, and large regions below the 25-inch isohyet. The sharp rise of land close to the coast, severely limits the arable land to a coastal strip. Compared with the map of J. B. Kincer, on Shantz's, and Marbut's Land Classification Map of Africa,⁵ the Lewis map, shows in far greater detail its close relationship of rainfall to topographic variations.

The variability in rainfall suggested the use of a novel rainfall clock map. Each space of the clock represents a month, the lower six months being the winter half-year and the upper the summer. Red and blue represent dry and wet months respectively, a dry month being one in which the average rainfall is under 0.7 of a twelfth of the annual total, while a wet month is taken as one having over a sixth of the annual mean. The average annual is the radius of a dotted red circle that determines the general size of the clock. The rainfall clock map is especially effective in emphasizing the differences in annual rainfall and seasonal distribution.

To differentiate further the differences in rainfall over South Africa three main zones are delineated; a west coast zone of winter rainfall, the south coast zone of even rainfall and a northeast summer rainfall zone. Sub-zones are also marked based on the concentration of rainfall within the large zones within designated portions of the rainy season.

As a large number of the rivers of the Union derive their waters from Basutoland and Swaziland, tables of the area with rainfalls between certain limits are presented, but should be regarded as very rough approximations.

The third map, of total yearly rainfall for selected years, is of the bar graph variety, each bar being divided into summer and winter halves (outline vs. solid). It illustrates the marked variability yet the difficulty of tracing periodicity in rainfall. The terminology chosen by the author is unusual in that he discusses the distribution of annual rainfall in terms commonly used for describing natural configuration from a contoured map, for example "spur," "kopje," "depression," "valley," "neck," "slope," "descent."

The section maps, showing station locations and isohyets of small areas, coupled with the voluminous index of rainfall stations, make this publication an effective tool for local use.—Donald S. Gates.

Tornado in New Mexico, by C. E. Linney.—A rather well defined tornadic storm occurred shortly after 5 p. m. May 31, 1930 at Wagon Mound, a small town on the Atchison Topeka & Santa Fe Railroad in eastern Mora County, N. Mex. On the morning of that date a cyclonic system of wind circulation in which tornadoes usually develop was centered about 300 miles to the west of Wagon Mound. Considering the nature of the storm winds and the destruction of between 40 and 50 homes and about 8 other structures devoted to business purposes and the meteorological conditions under which it occurred (in the southeastern quadrant of a cyclonic storm) there appears to be but little doubt as to the tornadic character of the winds. The storm appears to have developed about 3 miles to the south of the town

⁴ Rainfall Normals, Up to the End of 1925, with an Introduction and Brief Summary of the Rainfall of the Union of South Africa, by A. D. Lewis, director of irrigation. 109 pp., 35 maps. Published by Union of South Africa, Department of Irrigation, Meteorological Office, Cape Town, 1927. In Dutch and English. 8 by 12½.

⁵ H. L. Shantz and C. F. Marbut, Vegetation and soils of Africa, An. Geogr. Soc., Research Ser. No. 13, New York, 1923.

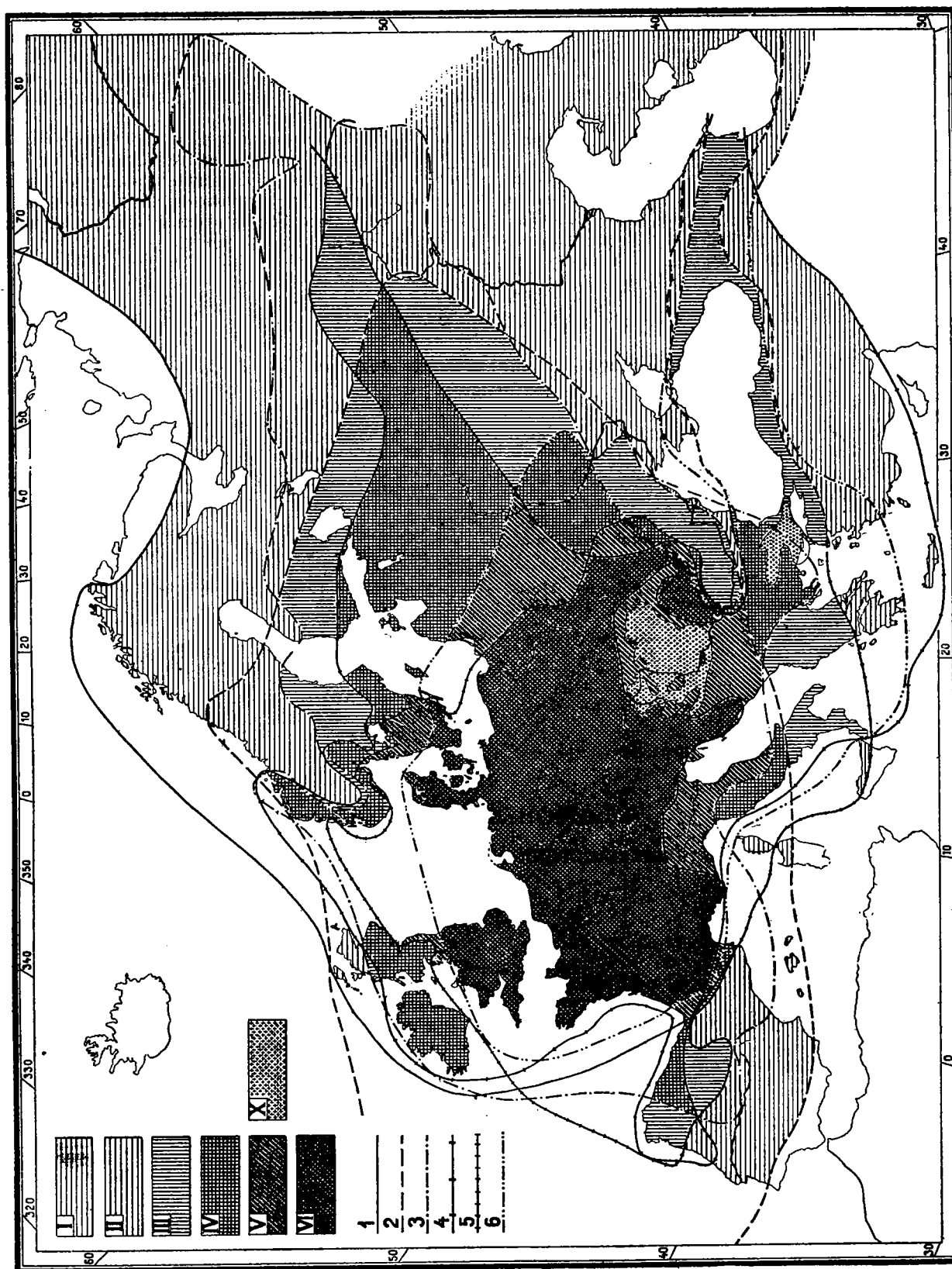


FIGURE 1.—Oceanic climatic influences as synthesised and represented by characteristic plants. I-VI, one or more plants present; X, areas in Hungary and Thrace where *Fagus* is lacking. Limits of *L. Calluna vulgaris*, beather; 2, *anemone nemorosa*; wood anemone; 3, *Tilia cordata*, small-leaved linden; 4, *Quercus robur*, English oak; 5, *Fagus sylvatica*, European beech; 6, *carpinus betulus*, European hornbeam.

and to have swept rapidly through it in not more than two minutes. No one appears to have paid particular attention to the appearance of the storm cloud as it approached Wagon Mound. No one observed a funnel cloud. Two women automobilists endeavored to escape the storm by speeding up their car; they encountered strong winds and severe hail.

The loss of life was two persons and a third has since died from his injuries, at least 20 others were injured and the property loss is estimated at \$150,000—(Condensed from the author's report—*Ed.*)

Oceanic, Continental, Mediterranean, and Boreal climatic influences and mountain climate in Europe, compiled by Count Paul Teleki, professor of geography, and Zoltán de Nagy practice in the Institute of Geography. Publications of the Geographical Institute of the Economic Faculty of the

University, Budapest, No. 1, 1930. Reviewed by Sigismund R. Diettrich.—The work contains a series of six maps showing the distribution of different plants characteristic of the various climatic types. Due to the careful selection of these representative plants the maps show the intensity of the various climatic influences in great detail. A seventh map presents the peoples and empires of the steppe belt of East Europe toward the end of the Great Migration.

It is a very useful series of maps, which can be used as reference material either in climates or in plant ecology. The last map illustrates clearly the geographic influences upon the migrations of the people in east Europe. Complete English text and explanation accompanies the work.

BIBLIOGRAPHY

C. FITZHUGH TALMAN, in Charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

- Academia Sinica with its research institutes. Shanghai. 1929. 69 p. plates (fold.) 20 cm. [National research institute of meteorology. p. 36-40.]
- Ångström, Anders.
Stora nederbörds mängder i Stockholm. Norrköping. 1930. 15 p. figs. 20½ cm. (Teknisk tidskrift. 1929. Häft 52.)
- Clayton, H. Helm.
Atmosphere and the sun. Washington. 1930. 49 p. figs. 24½ cm. (Smith. misc. coll. v. 82, no. 7.)
- Follansbee, Robert.
Upper Colorado river and its utilization. Washington. 1929. xv, 394 p. figs. plates (part fold.) 23½ cm. (U. S. Geol. surv. Water-supply paper 617.)
- Gavilan, Alfonso Reyes.
Nuevas teorías los ciclones. Habana. 1930. 32 p. 19½ cm.

- Helland-Hansen, Bjørn.
Nybygningen for det Geofysiske institutt. Bergen. n. d. 21 p. illus. 23 cm. (Bergens mus. årsberet. 1928-1929.)
- Knight, Montgomery, and Clay, William C.
Refrigerated wind tunnel tests on surface coatings for preventing ice formation. Washington. 1930. 21 p. plates. 26½ cm. (Nat. adv. comm. aeron. Tech. notes. no. 339.)
- Östman, C. J.
Snöstormsvarningar på riksgrensbanan. Norrköping. 1930. 15 p. figs. 20½ c. (Teknisk tidskrift, 1930. häft 1.)
- Pinkerton, Robert M.
Calibration and lag of a Friez type cup anemometer. Washington. 1930. 8 p. plate. charts. 26½ cm. (Nat. adv. comm. aeron. Tech. notes. no. 341.)
- Shaw, [William] Napier.
Manual of meteorology. v. 3. Physical processes of weather. Cambridge. 1930. xxviii, 445 p. figs. 27 cm.
- Wilson, Robert.
Planting and care of shelter belts on the northern Great Plains. [Washington. 1929.] 13 p. figs. 23½ cm. (U. S. Dept. agric. Farmers' bull. no. 1603.)

SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING JUNE, 1930

By IRVING F. HAND

For reference to descriptions of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to this volume of the REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged slightly above the normal intensity for June at Washington and Lincoln, and close to normal at Madison.

Table 2 shows an excess in the total radiation received on a horizontal surface at Washington, Lincoln, and Fresno, and a deficiency at Madison, Chicago, and La Jolla for the month.

Skylight polarization measurements obtained on four days at Washington give a mean of 54 per cent and a maximum of 56 per cent on the 21st. At Madison measurements obtained on seven days give a mean of 57 per cent with a maximum of 69 per cent on the 24th. These are close to the corresponding averages for June at Madison and slightly below at Washington.